



Selection of Welding Consumables and Care in Storage & Handling (HF, CI & Non Ferrous)

**By,
Rohit Raut
TDC - Consumables**



The Need For Hardfacing

- The constant problem of wear & tear due to abrasion, impact corrosion & friction have been reducing the outputs of the Sugar/Cement/steel/paper industry. Industry, considerably.
- The demand for non-stop, high performance operations puts considerably high pressure on the maintenance team.
- Reclamation welding is the most lucrative solution as it helps to minimize inventory & reduces down time.



What is Wear?

Wear is unintentional deterioration of the material/metal resulting from its use or exposed environment



Types of Wear

Primary

- Adhesion/Friction
- Abrasion
- Impact

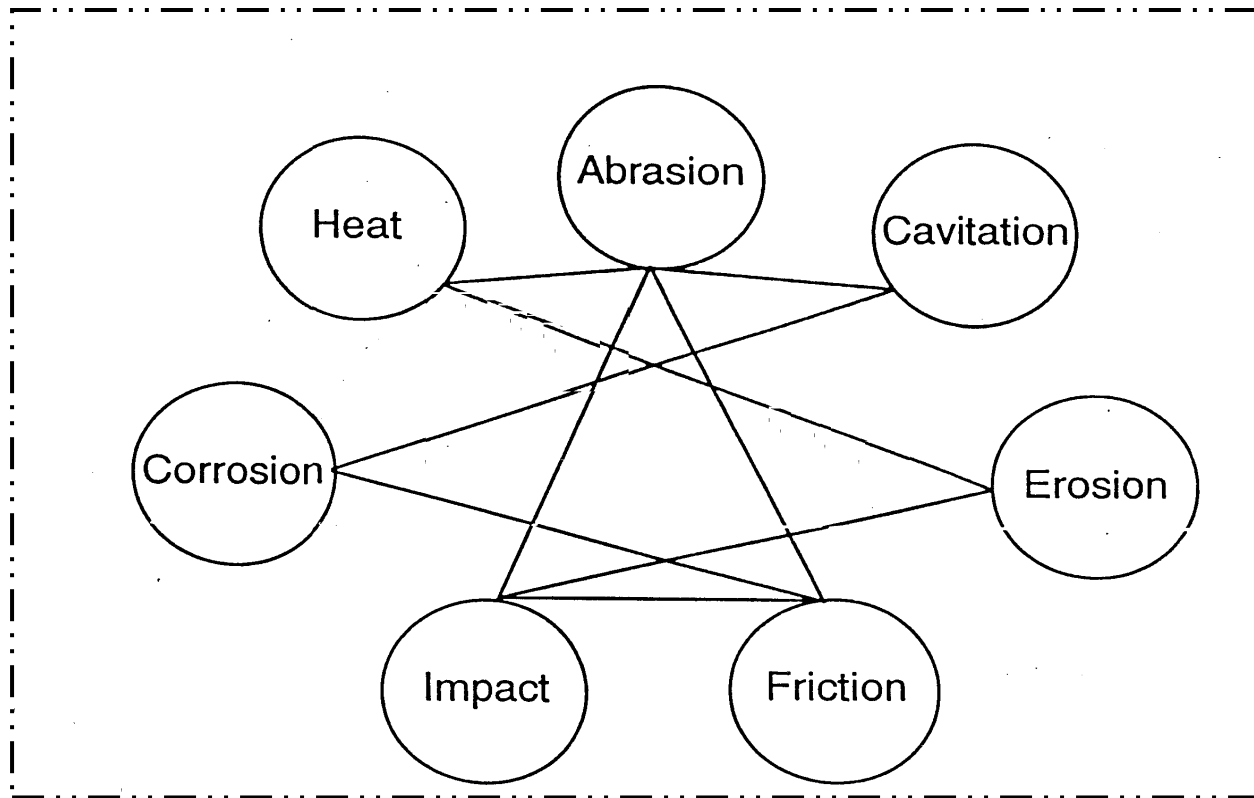
Secondary

- Cavitation
- Corrosion
- Heat
- Erosion



Wear Mechanism

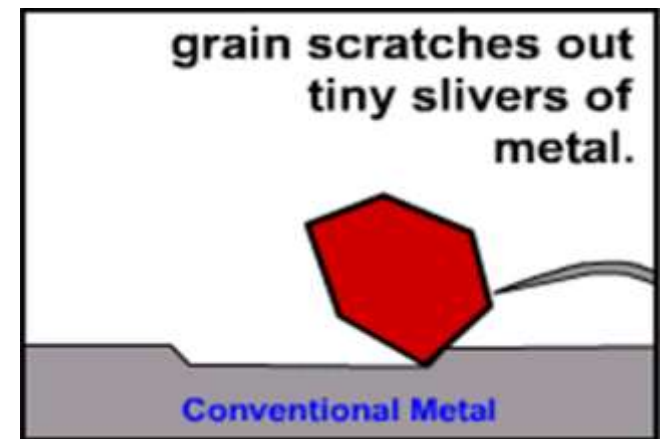
Combination Of Two Or More Wear Factors





Abrasion

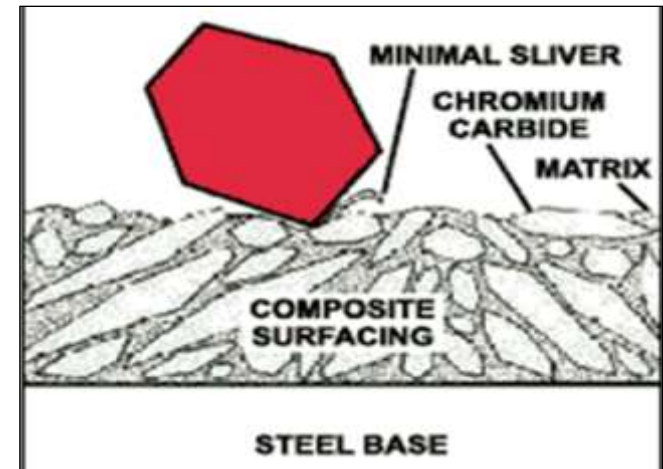
- The process of rubbing, grinding (or) wearing away by friction.





Abrasion

- Hardfacing on steel base provides resistance against scratching and wear.





Erosion

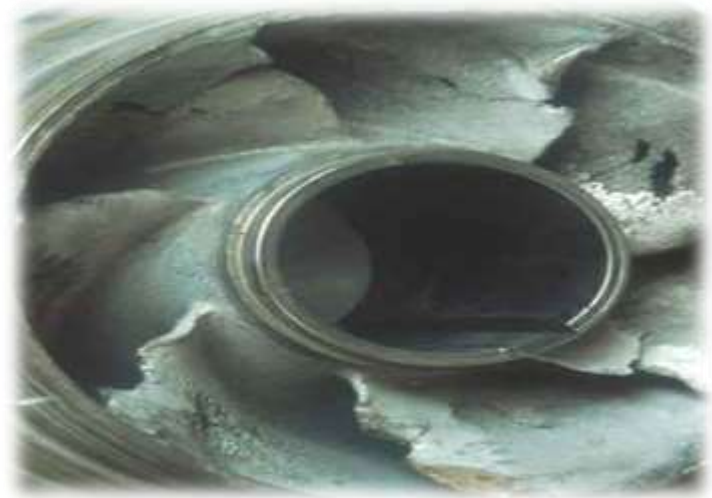
- Destruction of metals by abrasive action of moving fluids.
- Usually accelerated by the presence of solid particles in suspension.





Cavitation

- Formation & instantaneous collapse of innumerable tiny voids or cavities within a liquid subjected to rapid & intense pressure changes.





Oxidation

- A reaction in which there is an increase in valance resulting from loss of electrons.

Impact

- The energy per unit volume that can be absorbed by a material up to the point of fracture is called toughness



Introduction to Hardfacing

- Hardfacing is the deposition of thick coatings of hard, wear-resistant materials on a worn or new component surface that is subject to wear in service
- Hardfaced layers may also be characterised by the following properties:
 1. Soundness (cracks are acceptable in some cases).
 2. Toughness, depending on the need to resist impacts.
 3. Resistance to environmental stresses such as corrosion and high temperatures.



AWL HARDFACING SMAW ELECTRODES

Sr No	Brand Name	Sr No	Brand Name	Sr No	Brand Name
1	Zedalloy 250	8	Zedalloy 400B	15	Zedalloy Bell
2	Zedalloy 350	9	Zedalloy 600B	16	Zedalloy VB
3	Zedalloy 350 (LH)	10	Zedalloy 12Mn	17	Superzedalloy
4	Zedalloy 500	11	Zedalloy 16Mn	18	Superzedalloy Ni
5	Zedalloy 550	12	Zedalloy 16Cr	19	Maganacane
6	Zedalloy 550 (LH)	13	Zedalloy 20Cr	20	Zedalloy 16
7	Zedalloy 600	14	Zealloy K	21	Zedalloy CoCr-A



Zedalloy 250

Applications



Pulleys, **Shafts**,
Couplings, Spindles,
Excavators, Axles, Rail
points and crossings,
Track links, Tram tyres

Materials

Carbon steel upto 350
deg. C

Zedalloy 350

Applications



Excavator, Conveyor
parts, Supporting
rollers of Kiln tyres,
Plough shares

Materials

Carbon Steel upto 300
deg. C



Zedalloy 350 (LH)

Applications



Excavator, **Conveyor parts**, Supporting rollers of Kiln tyres, Plough shares

Materials

Carbon steel upto 300 deg. C

Zedalloy 500

Applications



Tamping tools
Crane wheel **Ingot tongs**, Forming dies, Cutting tools

Materials

Carbon Steel, Low alloy steel, tool steel upto 400 deg. C



Zedalloy 550

Applications



Excavator, Conveyor parts, Supporting rollers of Kiln tyres,
Plough shares

Materials

Carbon Steel, Low alloy steel, tool steel upto 350 deg. C

Zedalloy 550 (LH)

Applications



Caterpillar treads,
Bulldozer blades,
Bamboo chipper knives
Dis-integrator hammers

Materials

Carbon Steel, Low alloy steel, tool steel upto 350 deg. C



Zedalloy 600

Applications



Drilling bits, Punches,
Dies, Crane wheels,
Shear blades,
Crushers, Hammers

Materials

Carbon Steel, Low alloy
steel, tool steel upto
350 deg. C

Zedalloy 600B

Applications



Excavator parts, Bucket
teeth, Cane cutting
knives, **Metal cutting**
and forming tools

Materials

Carbon Steel, Low alloy
steel, tool steel upto
350 deg. C



Zedalloy 12Mn

Applications



Mn steel rails,
Hammers, Crusher
Repair of Mn Steel
casting, Crushing Jaws

Materials

Austenitic Mn Steel
Casting (Hadfield Steel)

Zedalloy 16Mn

Applications



Crusher rollers and
jaws, Pulveriser
hammers and beaters

Materials

Austenitic Mn Steel
Casting (Hadfield Steel)



Zedalloy 16Cr

Applications



Dipper teeth and lips
Coal mining cutters,
Rock Driller,
Pump housing

Materials

Austenitic Mn Steel
Casting (Hadfield Steel),
Stainless Steel

Zedalloy 20Cr

Applications



Screw flight, Sand
pump impellers
Conveyor rolls, Truck
chains, Pump housing

Materials

Austenitic Mn Steel
Casting (Hadfield Steel),
Stainless steel



Zedalloy K

Applications



Blanking and Forming dies, Cutting tools, Mining tools, **Shear blades**

Materials

Tool steel upto 400 deg. C

Zedalloy Bell

Applications



Blast furnace Bells & Hoppers, Steel mill equipment's, Tong pins, Metallurgical plants

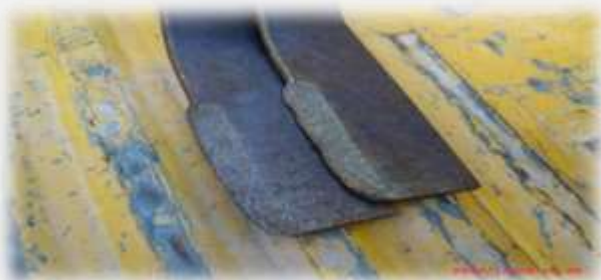
Materials

Carbon Steel upto 500 deg. C



Zedalloy VB

Applications



Concrete Mixer Blades
Muller Tyres, Dippers,
Shear and **scraper**
blades

Materials

Cast iron, Carbon steel
and Stainless steel

Superzedalloy

Applications



Coke chutes, Screws
Cultivator shovels,
Trash plate, Grinding
rings

Materials

High Strength cast iron,
Carbon steel upto 1000
deg. C



Superzedalloy Ni

Applications



Coke chutes, **Sinter plant disintegrators**, Cement clinker crushing rollers,

Materials

1100 deg. C temp resistant tool steel

Maganacane

Applications



For Spot-Arc building/roughening **Sugar mill rolls**, chilled cast iron rolls

Materials

Chilled Cast iron rollers



Zedalloy 16

Applications



Rolling mill guides,
Coal crushing
hammers,
Conveyor screws

Materials

Carbon steel upto 500
deg. C

Zedalloy CoCr-A

Applications



Valves, Valve seats
Sealing surfaces
Hot pressing tools

Materials

Stellite base material



Zedalloy 17Cr NS Plus

Applications



Surfacing of sealing
faces of
steam/water/gas
valve

Materials

All grades of stainless
steel



Example



Fisher Norris Anvil

Base Metal – Cast steel

Welding Consumable – Zedalloy K

Preheating temperature – 200 deg. (one hr/inch)



Procedure

- To repair the anvil, you will need to grind out the areas which have been chipped or cracked.
- Grind down to sound metal.
- You can do a dye penetrant test if you are comfortable and familiar with it to verify you ground past the base of any cracking
- Preheat the area to be welded to about 200 deg. C
- Deposit the chip-out part with Zedalloy K
- Grind out the excessive deposit to have the smooth surface



Sr No	Material	Recommended Consumable
1	MS to SS	Tenalloy 16/Betachrome N or ND
2	MS to Cast Steel	Tenalloy 16/Betachrome N or ND
3	Unknown Steel	Superinox 312
4	Spring/tool steel	Superinox 312
5	Armor Steels	Arminox
6	Machinable CI	Castnickel/Castmonel/Ferricast
7	Non Machinable CI	Casten
8	Austenitic Steels	Superinox 1A/1C/2A/2C/1B/2B
9	Dissimilar Steel	Betanox D/DI
10	Heat Resisting Steel	Betanox C/310 Plus/20/30/20/25/5Cu
11	Martensitic SS	Betachrome 13Cr/17Cr/13/4/17/4



Sr No	Material	Recommended Consumable
1	CuSn alloy, PB2 grade	Bronze
2	Pure Ni, 200 and 201 series, Ni-Fe alloy	Nicalloy 1
3	Ni-Cr-Fe alloy upto 800 deg. C	Nicalloy Fe-2
4	Inconel 600 and similar alloys	Nicalloy Fe-3
5	Cr-Mo-Nb alloy upto 1100 deg. C	Nicalloy Mo-3
6	C - 276 and similar alloy	Nicalloy Mo-4
7	Inconel 625/800	Nicalloy Mo-5
8	9% Nickel steel used for LNG tanks	Nicalloy Mo-6
9	wrought and cast Al alloys with Si upto 7%	Albond 5 Si
10	Aluminium alloy with typical 12% Si	Albond 12 Si



Care In storage and Handling

- Electrodes, when stored have tendency to pick up moisture. This tendency is more in case of low hydrogen electrodes as compared to rutile type electrodes. The flux coating on the electrodes absorbs moisture from atmosphere and if they are used subsequently, this moisture can result in porosity, hydrogen induced cracking etc. depending on amount of moisture absorbed.
- If electrodes are stored in a highly humid atmosphere, rusting of core wire of the electrodes can take place. All these can result in deterioration of mechanical properties of the weld metal



How to store the electrodes?

- It is preferable to store electrodes in cartons in a dry room. The electrodes or cartons should not come in direct contact with water. The ideal condition will be to store electrodes in cartons in suitable racks inside a room with relative humidity below 40%. This relative humidity can be achieved using dehumidifiers, electrical heaters, bulbs etc. The wall of room can suitably painted to maintain the humidity. The suitable dial –gauge meter can be used to measure the relative humidity continuously inside room



What if this not possible?

- If the above is not possible, then shelf life of electrodes depends on the way which it has been stored. Normally if electrodes are stored in normal room, away from moisture, without much of humidity, the electrodes can go through two monsoons. We refer to period monsoon, because it is this period the relative humidity is maximum in most of places.



How do we judge the moist electrodes?

- As thumb rule, in order to find out if electrodes have picked up moisture, the following method can be adopted. Pick up about ten electrodes from the carton and using both hands, hold them horizontally and roll them one over the other. If the sound produced in this process is metallic, then the electrodes have not picked up moisture. If the sound produced is dull, then it can be concluded that electrodes have picked up moisture



How to salvage?

- Check the packing whether it is intact. Remove the electrodes and see them physically for any rust in core wire, flux peeling etc. If these defects are present, then electrodes are not usable. Check the electrodes for moisture pick up as detailed above. Re-dry / re-bake the electrodes depending on the type and as recommended by manufactures. Weld a bead on a plate to check for any porosity or any visual defect after re-baking or re-drying as indicated earlier. If bead is satisfactory then in many cases electrodes can be used. However for additional safety, an All-Weld test for tensile and impact can be done to ensure mechanical properties are in range



Re-drying of Low Hydrogen Stick Electrodes

- Proper re-drying temperature depends upon the electrode type and its condition. Pl follow the manufacturer's recommendation as given in the label. Do not dry electrodes at higher temperatures. Several hours at lower temperatures will not give the same results as that of re-drying at the specified temperature and time. To minimize oxidation of alloying elements in the coating, no electrode should undergo re-drying at the specified temperature and time for more than 3 times. It is better to maintain at re-dried electrodes at temperatures between 100 – 150 deg C, rather than re-drying them again. Re-drying more number of times will also make the flux coating fragile. Once that happens, then those electrodes have to be discarded



Thank You